which, for the most part, reliance must be placed on uninformed agents, it will be absolutely necessary to issue very minute instructions, to be observed by the collector, that they may, with the least expenditure of time, do the best possible with the country they live in. More especially every inducement should be held out to all correspondents to send in wet preparations of the animals which occupy the shells, and dissection of parts, illustrative of their anatomy, preserved in spirits.

If the National Institution could succeed in establishing branch institutions in the various quarters indicated above, a measure which I would urge upon the early attention of the members, the harvest of species waiting to be gathered in would be accomplished so much the more speedily.

Respecting the willingness of gentlemen, especially those to whom I have referred, to undertake exchanges, I take this opportunity to bear testimony to the great liberality and promptitude which I have invariably found to actuate naturalists, though personally strangers to each other. I have attributed these noble qualities as much to the gentle influences exercised by their quiet pursuits, as the wish to extend the humanizing results which always attend the cultivation of science.

Washington University of Baltimore, *Dec.* 10, 1841.

OBSERVATIONS ON A PORTION OF THE ATLANTIC TERTIARY REGION, WITH A DESCRIPTION OF NEW SPECIES OF ORGANIC REMAINS: BY T. A. CONRAD.

Several circumstances combine to give interest and importance to the tertiary deposits of the Atlantic coast of the Union. These chiefly consist in variations from the usual characteristics of European tertiaries. The first which I shall notice is the remarkable connection of secondary with tertiary, or cretaceous with eocene deposits, by means of the following fossils, which I discovered in a tour in the Southern States in 1832, '33 viz: *Nummulites Mantelli*, (nob;) *Gryphæa vomer*, (Morton;) *Plagiostoma dumosum*, (Morton.) The white limestone of Alabama, which contains these fossils, is connected with the green-sand formation of New-Jersey, by three species of shells: *Ostrea panda*, *Ostrea cretacea*, and *Gryphæa vomer*, (*Ostrea lateralis*, Nillson.) The second important disagreement with foreign tertiaries is the absence of any trace of fluviatile remains. The *Gnathodon*, a bivalve inhabiting estuaries where the water is scarcely saline, and fresh during the inundations of the rivers, is the only evidence, hitherto obtained, of the occurrence of fresh water streams—a remarkable fact, considering the great extent of land which evidently was present in the tertiary periods. The third peculiarity of the American tertiaries is the abrupt line of demarcation between the fossil groups which they contain; showing no gradual passage or interchange of forms, although the relative levels, above the sea, are of no important variation among the three divisions into which I have grouped the tertiaries, for a convenient but temporary purpose. No one, I presume, would refer this wide difference of zoological character to any relative condition of sea or land, caused by earthquakes, or by an elevation of the beds above

the level of the sea; and, therefore, the only cause which presents itself to the mind of the inquirer is, a fall of temperature in the ocean, sufficient, at the close of the lower tertiary period, to have destroyed every kind of animal life, at least on the coast of North-America, because of two hundred species of the lower tertiary, not one exists on the coast, nor is found in the more recent formations of the Union.

The lower tertiary is certainly identical with the London clay and calcaire grossiere, or eocene formation; and I was led to the comparison, in the first place, by discovering the *Cardita planicosta*, a well-known characteristic fossil of the eocene period in Europe.* A single species of shell will thus occasionally indicate the stratagraphical relations of a formation hitherto obscure or unknown, and lead to inferences the most important, which he who underrates organic remains is apt to regard as visionary, but the palæontologist must acknowledge as useful and true.

At Upper Marlborough, Prince George's county, Maryland, and at other localities in Maryland and Virginia, green-sand, the same in mineral character with that of the cretaceous period, enters largely into the composition of the lower tertiary marls. In Georgia, and more rarely in Alabama, a portion of this formation assumes the character of burr stone, and the shells which abound in it are beautifully silicified. Near Piscataway and Upper Marlborough, the lower tertiary is somewhat similar, in general appearance, to the Bognor rocks of Great Britain, but of a coarser and more arenaceous texture. What is of more consequence, however, is the occurrence of a bivalve shell, characteristic of the Bognor rocks and of the eocene period—*Ostrea bellovacina*. This stratum is indurated, and overlies the eocene green-sand, but is evidently linked with it by a communion of zoological characters, at the same time that it contains a few species which appear to be peculiar to it. *Panopæa elongata* is the most abundant fossil, and a new Pholas, (*P. Petrosa*,) and a Pholadomya, (*P. Marylandica*,) I have met with only in this rock. Several other shells, which it holds, are identical with species of the lower tertiary at Claiborne, Alabama. The most interesting shell is Gryphæa vomer, (*Ostrea lateralis*, Nillson,) which originated in the lower division of the cretaceous system, was continued in the two upper terms, and reappears in the tertiary sandstone at Upper Marlborough in abundance, although no other fossil whatever, of the cretaceous group, has been found in that locality.

In company with my friend Francis Markoe, Jr., of Washington, I reëxamined the interesting deposits at Upper Marlborough, and was surprised to find the secondary species of Gryphæa scattered in abundance over the surface of the disintegrating rock, in company with the characteristic group of the eocene; for, on a former visit to this place, the shell was so rare that I supposed it to be accidental, or part of the ruins of an earlier era. The valves were never found united; but this is seldom the case in the New-Jersey green-sand deposits, where it is numerous. Although the lower valve is always more or less broken, the fracture has resulted from the fragility of the shell, in falling, through the agency of frost and rain, from the disintegrated rock. The upper valve is almost always entire, and neither is ever seen to be water-worn in the slightest degree. These considerations lead to the inference that the bivalve in question may have existed in the eocene period, constituting another link in the important chain of connection between the secondary

* Journal of the Academy of Natural Sciences of Philadelphia, 1830.

and tertiary formations of the United States. The species evidently existed in the newest of the cretaceous rocks, which contains two other tertiary fossils.

If it can be proved that no species of the secondary period was drifted by currents into the eocene ocean, it is not unlikely that the green grains of silicate of iron, which are probably of volcanic origin, were formed as well in the tertiary as the cretaceous epoch. Indeed, in many localities of the former period, in Maryland and Virginia, the green-sand is quite as abundant as in the secondary fossiliferous "marls" of New-Jersey.

The only localities of the lower tertiary which I have visited in Maryland, are at Upper Marlborough, Piscataway, and Fort Washington. It sinks beneath the medial tertiary beds, shortly after passing a line from the fort to Annapolis. Dr. Ducatel has detected it on the Potomac, opposite Crane Island, in Charles county. We know not any other locality southeast of this. The inclination of the tertiaries in Maryland is very slight, and towards the southeast; so that the Potomac, below Washington, presents sections of each of the three divisions. The same group of organic remains occurs throughout the lower tertiary, with little variation in species compared with the upper divisions. The lowest bed consists of green and siliceous sands, mixed with clay, in which the fossils are chalky, and fall to pieces with the slightest pressure. The upper stratum is of a coarse arenaceous texture, with green grains, and quite indurated in masses, which fall out as the other portions of the rock become disintegrated by frost. Here we observe many of the shells perfectly preserved in silex, which has completely replaced the calcareous matter, whilst others, as *Panopea elongata*, *Cucullæa gigantea*, &c., frequently consist of casts, with only a thin coating of the chalky calcareous matter of the original shells. *Pectunculus pulvinatus*, the variety described and figured by Deshayes, a very characteristic shell of the Paris eocene, is the most common of the silicified bivalves, standing in bold relief on the surfaces of the indurated masses. *Cardita Blandingi* is rare, and much smaller than the same species which occurs so abundantly in the sand at Claiborne, Alabama. The large *Cucullæa gigantea* abounds in the vicinity of Fort Washington; but in the synchronous deposits of Piscataway and Upper Marlborough, it does not occur. Of course some variation in the group of species will be observed in every different locality; but it is far less in amount in the lower than in the newer tertiaries. There is also great difference in size among some species, when compared from different localities. *Cardita planicosta* is much larger in Maryland than in the sand at Claiborne; and *Turritelli Mortoni*, of Maryland, is gigantic in comparison with the largest specimens at Claiborne.

The lower tertiary occurs on James river, near City Point, Virginia; a most interesting locality, from the juxtaposition of this formation with the medial tertiary, in which the organic remains of both are brought almost into contact, and yet not one species of any class of fossils is common to both. Here the remarkable oyster, *O. sellæformis*, separates the group of oceanic lower tertiary shells from those of the medial tertiary. At Claiborne, this *Ostrea* divides the eocene oceanic beds by an interval of seventy feet. This shell connects the white limestone of Vance's ferry, Nelson's ferry, and the Eutaw springs, South-Carolina,* with the eocene of

* In 1832, I found abundance of *Ostrea sellæformis* at Nelson's ferry, on the Santee river, but associ-

Alabama, and is, perhaps, the most unvarying and curious in shape, and certainly one of the most easily recognised of the irregular forms of this difficult genus. It has a most important claim to the attention of the speculative geologist, for, like the *lithodomus* marks on the pillars of the temple of Serapis, I conceive that it affords evidence of a rising above and sinking beneath the level of the sea, of the lower tertiary beds of Alabama. Wherever we find a continuous deposit of fossil oyster-shells, we recognise an ancient estuary, bay, or lagoon, cut off from the main ocean; for in no geological period were these bivalves ever colonized in the open sea, although they were liable to have been occasionally drifted there by currents. To present a clear view of the subject, I subjoin a section of the cliff at Claiborne, with a description, originally published in the Journal of the Academy of Natural Sciences of Philadelphia, in 1834, and in my work on tertiary fossils, in 1835. The section is in the ascending order.

	Right bank of Alabama river at Claiborne.	
4	Argillaceous limestone,	45 feet.
	- indurated,	3 feet.
3	Group of shells, similar to those of the Paris eocene,	17 feet.
	Ostrea sellæformis, in indurated sand,	3 feet.
2	Dark colored clay, with Ostrea sellæformis,	70 feet.
1	Sand and clay, with oceanic shells, same as in No. 3.	

Level of the Alabama river, in the lowest stage of the water.

1. The inferior stratum is a dark-colored mixture of sand and clay, containing a group of shells, many of the species of which occur in the arenaceous deposit, No. 3 of the section.

2. A dark-colored clay or marl, seventy feet in thickness, characterized by *Ostrea sellæformis*, generally of a small size, with disunited valves, and rather sparsely

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ated with a different group of fossils from any I had observed in Alabama. In Dr. Morton's "Synopsis of the Organic Remains of the Cretaceous Group," the white limestone, in which this oyster shell occurs, was referred to the upper division of this group; but further investigation of the fossils has satisfied me that they are of eocene origin. Two species of organic remains which occur in the limestone, (*Scutella Lyelli* and *Pecten calvatus*,) I have obtained from the newest stratum at Claiborne, No. 4 of the section; but this Carolina limestone I believe to have been deposited in estuaries, like stratum No. 2, of the Claiborne section, with which it is doubtless of precisely the same geological age. Dr. Blanding, many years since, presented me specimens of *Ostrea sellæformis* and *Cardita Blandingi*, which he found at Vance's ferry, on the Santee river, and which enabled me to connect the formation of that locality with the eocene of Alabama. The following is a list of the fossils which I found in 1832, in the different localities of lower tertiary limestone in South-Carolina: Conus gyratus, Olivia carolinensis, Cypræa lapidosa, Ostrea sellæformis, Pecten calvatus, P. membranosus, Tenebratula lachryma, Balanus peregrinus, Scutella Lyelli, Lunulites Lyellii L. carolinensis, Echinus infulatus, Anthophyllum cuneiformis.

distributed: Other fossils are very rare. I found a specimen of *Plagiostoma dumosum* (Morton) attached to an oyster-shell, which appears to be the only evidence of the existence of that extinct genus in a tertiary deposit. Overlying this stratum is abundance of the same *Ostreæ*, in about three feet thickness of sand, cemented by carbonate of lime. Large specimens generally have a water-worn appearance, and occur mostly in single valves; but I found a few whole, unworn, very perfect shells. The young, which are vastly abundant, are also free from any marks of attrition, but are almost universally with disunited valves.

3. The next in order is a stratum of incoherent sand, of a ferruginous color, consisting of angular grains of quartz, and crowded with shells, in a fine state of preservation, which, though friable, may nearly all be obtained entire, by taking time and great care in collecting them. Here are about seventy genera, and rather more than two hundred species of organic remains. Those bivalves which have a strong ligament, as the *Lucinæ* and larger *Crassatellæ*, generally have the valves in apposition and the cartilage still remaining. The *Cytherea æquorea*, which resembles *C. suberycinoides*, (Deshayes,) the most abundant fossil at Claiborne, very seldom has the valves in connection; but if there has been any disturbance, at the time of deposition, it has been insufficient to injure the most delicate angles and striæ of the shells. Occasionally, specimens are found which still retain their colored markings. The surface of this stratum, where a portion of the sand has been washed away by rain, presents the aspect of a solid bed of shells. Near the base of it, whatever point was examined, a vein of soft lignite was present, and, what is remarkable, certain fine large univalves appeared almost confined to this lignite, as if it had been formed from vegetable substance, in the eocene ocean, to which these univalves were partial. Beneath this line, the sand is somewhat coherent, and many species of shells are more rare, whilst others are more abundant than above it.*

4. This stratum consists of argillaceous limestone, more or less friable, and about forty-five feet in thickness. It contains a few obscure casts of shells, referable to species imbedded in the sand beneath. *Scutella Lyelli* is the fossil of most frequent occurrence, but is also in great abundance in the sand, whenever that is sufficiently coherent to preserve its form. This rock somewhat resembles the newest member of the cretaceous group, which I found six miles west of the village of Claiborne; but a very dissimilar group of fossils shows the difference in age at a glance; and at St. Stephens, on the Tombeckbee river, the latter passes under the lower tertiary beds, as seen in the precipitous cliff.

At the base of the Claiborne section, we observe such a group of shells as lived only in the open sea. Estuary shells are more rare among them than is usual in marine deposits; for currents setting into the ocean generally carry with them the dead shells of estuaries, which may be frequently observed cast up on the beaches of the present seas. The eocene deposit of the Paris basin contains, it is well known, one hundred and thirty-seven species of the genus *Cerithium*, which clearly indicate the ancient occurrence of an estuary or arm of the sea. Now, in the con-

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* In the sand I found the following fossils of the Paris basin: *Solarium patulum*, (Lam.,) *S. canaliculatum*, (Lam.,) *Bonellia terebellata*, *Sigaretus canaliculatus*, (Sow.,) *Calyptræa trochiformis*. (Lam.,) *Pyrula tricarinata*, (Lam.,) *Avicula trigona*, (Lam.,) *Cytherea erycinoides*, (Lam.,) *Corbis lamellosa*, *Cardita planicosta*, *Fistulana elongata*, *Pectunculus pulvinatus*.

temporaneous deposit at Claiborne, a mere trace of this genus was all I could find during a protracted investigation of the fossils. If we suppose, then, the lowest bed at Claiborne to have been deposited in the ocean, we must infer this to have been elevated until it was cut off by a beach, and thus converted into a lagoon, because the group of oceanic shells was suddenly interrupted, and the *Ostreæ* began to congregate upon them in the land-locked and calm water. These, in their turn, were as suddenly banished by the sinking of the coast, which converted their harbor into the open sea, and restored the oceanic shells to their original position.

Although I believe the rise of land to have been generally by insensible degrees, through the agency of the crystallizing force acting throughout primary or granitic rocks, yet for this sudden interruption of groups from an oceanic to an estuary character, some other explanation seems necessary. Two theories only present any claim to our attention: one is, that a sand bar might have been suddenly formed by a violent tempest, which permanently remained to protect the shells in the lagoon; and the other, and perhaps more probable solution, is, that during an earthquake the land may have been suddenly elevated. The sea was cut off from its original beach by a bar, previously under water at all tides, but now constituting an embankment, which the ocean might never again be destined to pass. Of this conversion of sea into land-locked water, we see proofs every where throughout the three tertiary divisions, but of the conversion of the latter into the former, or sinking of the land, I am acquainted only with the solitary but interesting example at Claiborne. I know not in what estimation others may hold this phenomenon as evidence of the sinking of the land, but to my mind it appears as conclusive as the perforations of *lithodomi* on the columns of the temple at Puzzuoli, so admirably illustrated by Lyell.

Classification of Tertiary Formations.—It is doubtful, in the comparison of tertiary deposits, whether the relative amount of recent and extinct species may not be carried to an extreme injurious to science, especially before all the fossil as well as the recent forms shall be obtained. In the strata above the eocene, especially, is great care requisite in this mode of comparison, as the groups vary so continually in localities separated by an inconsiderable interval, that the fossils of the one shall be nearly or quite all of extinct species, and those of another shall embrace several existing forms. Nor can there be any doubt of the synchronous nature of these deposits, when we refer to the medial tertiary formation, because, taking a general view of the palæontology of the region, it is found to characterize a single era in the clearest and most satisfactory manner. Even when we trace the deposits in their horizontal continuation throughout a long line of coast, like that of the Chesapeake bay, we begin at one extremity, with a certain class of shells, which gradually drop some and acquire other forms, as we proceed towards the opposite termination of the beds, where there will be found scarcely a species in common with those at the spot where we commenced observation. In my first explorations in Maryland, I was greatly surprised to find a group of shells on the Choptank river, near Easton, which scarcely held a fossil in common with the localities I had previously studied on the western Peninsula, yet I could not doubt the contemporaneous origin of all these beds; and I subsequently found nearly the same group on the shore

of the Patuxent, below Benedict. As we trace the strata south, the species found on St. Mary's river, make their appearance, and yet the group of the latter locality compared with that nearest to Benedict, will be found to hold scarcely one kind of fossil in common. I have seen from Italy and Great Britain, organic remains so similar in general character, though mostly of species different from those of the medial tertiary of the Union, that I could not doubt the geological relations to be the same, and hence the inference, that a comparison of tertiary formations in distant countries, will exhibit by peculiarity of forms, and not unfrequently identity of species, the evidence of having originated at the same period of time. According to the classification of formations upon the relative amount of recent and extinct forms, that which we have designated as the medial tertiary formation, comes within the limits of the miocene. Yet, it is singular that a greater amount of difference should exist between the eocene and miocene, or two consecutive divisions of the tertiary, than obtains between secondary and tertiary, or between the devonian and carboniferous systems. No single form connects the lower with the medial tertiary formation, even when they are in juxtaposition; yet three species of organic remains link the upper secondary with the lower tertiary group of this country. It is, therefore, not unlikely that some deposits may yet be found, which occupy a position between the lower and medial tertiary, connected with both by the interchange of a certain number of forms, as is the case in Europe. There may be such a formation, circumscribed within narrow limits, or it may have been swept away in one of those unfathomed revolutions, which have so mysteriously and so frequently passed over the surface of the globe.

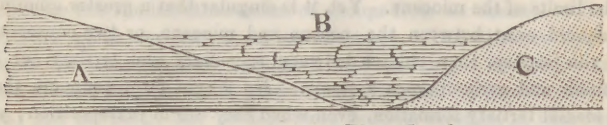
The following table will exhibit the most prominent characters of the supracretaceous formations of the Atlantic coast, premising, however, that of the two newest of these, the relative position is yet undetermined.

Table of Atlantic Supracretaceous Deposits.

	Elevation above the sea.			Localities.
Upper Tertiary.	200 feet.	Pleistocene.	Organic remains chiefly of existing species, supposed as a group to show evidence of a lower temperature in the period of their deposition than prevails now in the same parallel; yet most of the species live on the coast of Massachusetts.	Lake Champlain; St. Lawrence river.
	15 feet.	Or	Organic remains, the same as occur recent in the neighboring waters.	Raritan bay; many of the beds of *Ostrea virginiana* in Maryland and Virginia.
	12 feet.	Post-Pliocene.	Organic remains chiefly of recent species, but some of which now exist only in more southern latitudes, as the Gulf of Mexico. The most remarkable of these is *Gnathodon cuneatus*.	Neuse river, below Newbern, N. C.; beds of Gnathodon on Potomac, St. Mary's county, Md.
Medial Tertiary.	100 feet.	Miocene.	Organic remains with about seventeen per cent. of known recent species. No form of the lower tertiary found in this division.	Eastern counties of Maryland, Virginia and N. Carolina.
Lower Tertiary.	200 feet.	Eocene.	Organic remains similar as a group to those of the calcaire grossiere and London clay; many species identical with the eocene fossils of the Paris basin. No recent species.	Claiborne, Al.; Natchez, Mis.; Washita river, La.; Fort Washington, Piscataway, and Upper Marlborough, Maryland.

I have here given a view of all the strata known above the white limestone which prevails so extensively in Southern Alabama and Georgia, and which is evidently a link in the widely distributed cretaceous series. The lower tertiary in the Southern States is generally in limited basins or depressions in this limestone. Although at Claiborne the actual junction or relative position of the two formations is not exhibited, yet the latter rock can be traced, as well as identified by its fossils, from a spot six miles west of Claiborne to St. Stephens on the Tombeckbee river, where it is seen to underlie the lower tertiary strata, a short distance north of the village. The following section, though constructed from recollection after a lapse of seven years, will convey an idea of the cliff at St. Stephens.

St. Stephens.



River Level.

A. Newer cretaceous limestone.
B. Alluvium.
C. Eocene.

I have already indicated those fossils which are common to both formations, but it is not unlikely than another of great importance will yet be added to the number. This is the *Zeuglodon*, or the gigantic *Basilosaurus*, found on the Washita river, in Louisiana, completely enveloped in eocene fossilliferous "marl." It is yet, however, uncertain whether this envelope may not have fallen from the cliff above upon the exposed remains, though their tertiary origin is more probable. In the limestone, specimens of the jaws and teeth, and many vertebræ have been discovered. I received some years since, from Alabama, some of these remains, and the vertebræ were reported to have laid upon the ground when first discovered, in so regular a line, as to suggest the idea of their having been undisturbed from the time of the animal's death. Judging from the extent of this line of vertebræ, the *Zeuglodon* was supposed to have been one hundred and fifty feet in length, which is doubtless a great exaggeration. Portions of nine individuals, it is said, have been found in Alabama.

The following fossils, most of them described by Dr. Morton, constitute the group by which this formation is recognised: *Nummulites Mantelli*, *Pecten perplanus*, *P. Poulsoni*, *Plagiostoma dumosum*, *Ostrea panda*, *O. cretacea*, *Modiola cretacea*, *Gyphæa vomer*, *Nautilus alabamensis*, *Scutella Rogersi*.

The rock is finely developed, and the fossils very numerous, between Claiborne and St. Stephen's, in Alabama, particularly at the latter locality, where myriads of the *Nummulites Mantelli*, (Morton,) cover the surface of the decomposing rock.

Geographical range of Lower Tertiary.—The most northern locality I have seen is near Long Branch, in New-Jersey, where the fossils, though generally casts in marl, with a chalky coating, are very readily identified with the Claiborne species. The localities in Maryland have already been indicated. In Virginia, the formation occurs on the Rappahannock, below Fredericksburg, on the Pamunkey river, and

on the James river, two miles below City Point. In Georgia, in several of the eastern counties, burr stone of the lower tertiary period prevails.* On the Chatahoochie river, near Fort Gaines, is a cliff similar to that at Claiborne. Near Black's Bluff, in Wilcox county, Alabama, at Claiborne and St. Stephen's, are the only localities yet known in that State. In Mississippi, I recognise the formation by fossils from the Walnut Hills and Vicksburg, and there is every reason to believe a portion of the high bank at Natchez belongs to the same geological period. On the Washita river, Louisiana, the formation is well developed, near the town of Monroe; and it has also been discovered in Arkansas on Red river.

Geographical range of the Medial Tertiary.—I discovered many years since a locality of this formation on Stow creek, Cumberland county, New-Jersey, the most northern limit with which we are yet acquainted. In Maryland, it occurs near Chestertown, Wye Mills, on Choptank river near Easton, and other places on the Eastern shore; also, throughout the counties of St. Mary's, Calvert, &c.; and on the Western shore, in Virginia, the counties east of a line drawn from Tappahannock to Murfreesborough, are chiefly of this formation, which continues through North-Carolina, in all the eastern counties. It occurs near the junction of the Congaree and Wateree rivers, in South-Carolina, and this is as far as it has yet been traced south.

Localities of the Upper Tertiary.—The first view of this formation,† which I obtained, was on the Potomac river, a few miles above Point Lookout. Subsequently I discovered another on the Neuse river, below Newbern, in North-Carolina, resting upon the medial tertiary; and on the Potomac, in St. Mary's county, Maryland, is a bed of *Gnathodon* of the same geological age. Many of the deposits of *Ostrea virginiana* found in various places over the medial tertiary strata, are referable to the same period. On the shore of the Chesapeake, below the Patuxent river, is another locality. The same formation underlies the city of Charleston, South-Carolina, and is penetrated by some of the wells. Dr. Emmons has discovered on the borders of Lake Champlain and elsewhere, in the northeastern section of New-York, fossils

* This burr stone was referred by me to the eocene period in 1835, in the "Transactions of the Geological Society of Pennsylvania," vol. ii, page 336, and also the fossiliferous beds of Orangeburg, South-Carolina. The evidence was derived from organic remains collected by Dr. Wm. Blanding and Mr. Vanuxem. Cytherea peronata, a common eocene species at Claiborne, is, perhaps, the most abundant fossil of the burr stone. In my "Fossil Shells of the Tertiary formations of the United States," (1835,) page 31, the following notice of the lower tertiary occurs: "From Vance's ferry, the line of the eocene runs a little to the south of west, and, passing through the town of Orangeburg, crosses Savannah river at Shell Bluff, which is its boundary on the west. This formation appears, at intervals, in a distance of forty miles, following the course of the river." Shell Bluff, according to the observations of Mr. Vanuxem, is seventy feet high, formed of various beds of impure carbonate of lime. The "Ostrea Georgiana," (which I believe to be O. longirostris, a fossil of the eocene near Paris,) is here in a bed, nearly six feet thick, in the upper part. A deposit of the same kind of oyster shells occurs near Milledgeville, in Georgia, accompanied by the Scutella quinquefaria, (Say,) imbedded in white friable limestone. Three parallel ridges of these oyster shells are said to run from the Savannah to the Alatamaha river.

† For description of this locality, and list of fossils, see Journal of the Academy of Natural Sciences, vol. vi, p. 207, 1830.

identical with those of the St. Lawrence river, Sweden and Norway, referred by Mr. Lyell, to the post-pliocene period.

The upper tertiary is divided in the table into three sections, not that I would assert positively that there is much, if any difference in age, but because of the peculiar groups and distribution of species. The lowest section is most unlike the two upper, in consequence of exhibiting a group of shells approximating that living in the Gulf of Mexico, but it must be remembered that some species ranging as far north as Massachusetts, also occur with the fossils, and that probably when these were living in the sea, the peninsula of Florida was yet submerged. This form of the coast would have given the Gulf stream more influence in distributing southern forms far northward along the coast. But some change of climate, at the close of this period, seems not improbable from the circumstance that the common estuary fossil of the Gulf of Mexico, *Gnathodon cuneatus*, of Gray, was banished from the brackish waters of Georgia, South and North-Carolina, Virginia and Maryland, at this geological epoch. This shell lives so far from the sea, in mud flats, exposed at low tide, that it is not likely to have been destroyed by any change in the Gulf stream, or a receding of its imparted temperature from the coast. If this alteration of temperature can be established by new investigations, the deposits can hardly be of the same age as those of Raritan bay and the St. Lawrence river. In the former locality, there is no evidence of the slightest variation of temperature from the historical period, whilst the latter is supposed to contain a group peculiar to higher latitudes. This, however, wants confirmation, since most of the species are known to exist on the coasts of Maine and Massachusetts.

Medial Tertiary Period.

In a recent excursion with my friend Mr. Markoe, I made a hasty examination of some localities in Anne Arundel, Calvert, and St. Mary's counties. Except the lower tertiary at Upper Marlborough, these were chiefly referable to the medial tertiary period. The first point of observation was near Fair Haven, Anne Arundel county, where Mr. Markoe had previously obtained some interesting relics. This is the northern extremity of the formation on the west shore of the Chesapeake; a line run from Fair Haven to a point opposite Crane Island, in the Potomac, dividing the lower from the medial tertiary. At Fair Haven we observe a range of coast about fifty feet in elevation. Valleys of denudation sloping to the shore of the Chesapeake, interrupt the continuity of the bank, which presents a front of isolated perpendicular cliffs at irregular intervals. The lowest bed, which is on a level with the tide, is composed of clay, containing a stratum of Ostrea percrassa, a new Pecten, P. Humphreysii,* and other undetermined shells. This stratum rises to the height of about five feet above the level of the bay. Above is a light-colored clay, containing great numbers of black water-worn siliceous casts of small shells, chiefly Turritella, the species not yet determined. To this succeeds a whitish clay without fossils.

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* Named after Dr. Humphreys, of St. John's College, at Annapolis.

Section at Fair Haven.

Feet in thickness.

50	Whitish clay.
	Bones of cetacea.
3	Clay, with siliceous casts of marine shells, and fragments of bones.
5	Clay, with Ostrea percrassa, Pecten Humphreysii.

Bay. S. N.

This locality is interesting from the phenomenon of fissures or vertical joints, similar to those of primary and silurian rocks, traversing the whole strata without interruption, evidently the result of the same general cause which has produced the jointed structure of ancient rocks.

The next point to which our attention was directed, is near Colonel Blake's, on the Chesapeake, about twenty miles south of Fair Haven, where the cliff is at least one hundred and fifty feet high. At base we found a clay replete with a species of Tellina, probably new, and over this, at about six feet elevation, a thin stratum of Ostrea percrassa. The upper portion of the cliff consisted of sand and clay, and appeared to be destitute of organic remains.

A few miles south, upon the bay shore, we came to an interesting ravine on the farm of Captain Hance, a locality I had visited last spring. A small stream has worn a channel in the bank, and exposed beds of a mixture of sand and clay, very incoherent in general, and the fossils extremely numerous, though difficult to procure in the usual state of perfection of medial tertiary shells. The elevation is but a few feet above the level of the bay.

The species obtained here are comprised in the following list: the recent species in *italics:*

Bivalves.

Astarte varians, Conrad.
Astarte exaltata, Conrad.
Artemis acetabulum, Conrad.
Arca subrostrata, Conrad.
Arca depleura, Conrad.
Cytherea subnasuta, Conrad.
Cardium leptopleura, Conrad.
Crassatella melina, Conrad.
Corbula idonea, Conrad.
Corbula elevata, Conrad.

Bivalves.

Isocardia Markoéi, Conrad.
Lima papyria, Conrad.
Lucina Foremani, Conrad.
Lucina subplanata, Conrad
Lucina crenulata, Conrad.
Pectunculus lentiformis, Conrad.
Venus latilirata, Conrad.
Venus Mortoni? Conrad.
Venus staminea, Conrad.

Univalves.

Bonellia lineata, Conrad.
Cancellaria biplicifera, Conrad.
Cancellaria engonata, Conrad.
Dentalium thalloides, Conrad.

Univalves.

Pleurotoma bellacrenata,
Scalaria pachypleura, Conrad.
Solarium trilineatum, Conrad.
Sigaretus fragilis,

Univalves.	*Univalves.*
Fissurella marylandica, Conrad.	Trochus peralveatus, Conrad.
Voluta mutabilis, Conrad.	Turritella indenta, Conrad.
Infundibulum perarmatum, Conrad.	Turritella exaltata, Conrad.
Marginella perexigua, Conrad.	Turritella perlaqueata, Conrad.
Pleurotoma marylandica,	Voluta solitaria.

Following the coast three or four miles south, we observed another vertical cliff, about thirty-five feet in elevation, near Captain Beckett's. The fossils can be traced nearly to the last mentioned locality. At base is a brown mixture of sand and clay, with the same group of shells above mentioned, which are very numerous in a bed four feet in thickness. Specimens are difficult to obtain in quantity, as they must be procured in a low cavern hollowed out by the waves. In the next three feet, the same fossils occur, less abundantly; then succeeds twenty feet of mingled sand and clay apparently destitute of fossils. Above, and resting on this, is a stratum about three feet thick, of quartzose sand, very incoherent and filled with shells, among which I recognised *Artemis acetabulum*, Orbicula lugubris, and Pecten Madisonius; but the bed being inaccessible without a ladder, the amount of species could not be ascertained.

Cliff near Beckett's.

Ft. in thickness.	
5	Sand, without shells.
3	Sand, with innumerable shells.
20	Mingled sand and clay, without fossils, or very rare.
3	Same as below, less numerous.
4	Sand and clay, with a group of shells like that at Hance's.

The fossilliferous cliffs of the medial tertiary period extend from here to the mouth of Patuxent river.

Through the kind attentions of Dr. James and Dr. G. Granger Tongue, we were enabled to make some interesting excursions in the lower part of Calvert county; but I regret our limited time allowed us only a rapid glance at the long line of coast, both on the Chesapeake and Patuxent, so replete with interest to the geologist, and so rich in organic remains. Commencing near the southern extremity of Calvert, we coasted the Chesapeake, in front of the usual mural escarpment which characterizes the tertiary cliffs of this region, and which continues to the vicinity of Cove Point, where the land slopes gradually to the beach. At the point where we commenced observation, vast quantities of the Turritella plebeia, the common species of St. Mary's river, appear in veins or thin beds, in clay, just above the level

of the tide. Over these is a stratum of sand ten feet thick, in which the same shell abounds. To this succeeds the group most characteristic of these tertiary deposits, imbedded in sand, the prevalent species consisting of *Artemis acetabulum*, a large Venus, *Cytherea Sayana*, C. Marylandica, Corbula idonea, C. cuneata, and Pecten Madisonius. A fine large Mactra, M. ponderosa, which abounds on St. Mary's river, occurs here, but is rare. The univalves are, Fulgur coronatus, F. fusiformis, Fusus parilis, *F. cinereus*, *Buccinum trivittatum*, and *B. lunatum*. The last three species, as well as *Artemis acetabulum*, are living on the Atlantic coast. The large Balanus proteus is abundant. Above this fossilliferous sand is a mixture of sand and clay, without organic remains. Proceeding along the shore, we soon lose sight of the Turritellæ, and Pecten Madisonius makes its appearance in great abundance. The shells here are highly ferruginous, as much so as many of the crag fossils of Great Britain, which they greatly resemble, also, in other respects. Ferruginous masses, which have fallen from the cliffs above and mingled with the wreck of pine trees, greatly impeded our progress along the shore. These indurated fragments cover the beach for some miles, and are full of fossils, among which the large Pectens are most conspicuous. From the cliff, in the vicinity of Cove Point, Mr. Markoe was fortunate enough to obtain, through the assistance of Dr. Tongue, a large skull and upper jaw of a new species of Delphinus. Dr. Wyvill, the keeper of the light-house at Cove Point, furnished us with an interesting history of Cove Point, by which it appears that the bay has made rapid inroads on the north, and extensive deposition of sand on the south. Indeed, the light-house is now in imminent danger of being undermined, and appeared to us to demand the immediate attention of the Government, to save it from being swept away.

While on the subject of the geology of Calvert, I will notice a locality on the estate of Mr. George Wilkinson, at Huntingtown, in the northern part of the county, three or four miles from the Patuxent, to whom we are indebted for every assistance, and for hospitality, for which Calvert county is proverbial. In a depression or small valley, Mr. Wilkinson has excavated a race-way through the fossilliferous "marls," which presents the following section:

2. Blue marl, with shells similar to the group at Captain Hance's.
1. Quartzose sand, with casts of Perna maxillata.

The fossils observed here are the following species: A new Balanus, B. incile.

Bivalves.—Arca dipleura, Corbula idonea, (Conrad,) Crassatella melina, (Conrad,) Ostrea percrassa, (Conrad,) Pecten Humphreysii, (Conrad,) P. Madisonius, (Say.,) Pholas ovalis, (Say.,) Perna maxillata, (Lam.,) Orbicula lugubris, (Conrad,) Pectunculus lentiformis, Venus staminea, (Conrad.)

Univalves.—Bonellia lineata, (Conrad,) Fissurella marylandica, (Conrad,) Pleurotoma ———, (new,) Trochus peralveatus, (Conrad,) Turritella indenta, (Conrad.)

Coral.—Madrepora palmata, (Goldfuss.)

Three miles from Mr. Wilkinson's, in the bottom of a ravine, great numbers of Perna maxillata and Orbicula lugubris, are imbedded in lead-colored clay. About one mile from this, I observed the following species: Crassatella marylandica, Corbula idonea, Cytherea marylandica, Astarte obruta, Ostrea percrassa.

Dr. Granger Tongue having proposed a visit to St. Leonard's creek, we coasted, in a small sloop, up the Patuxent, from near Point Patience to the mouth of the creek. This point is a remarkable spot, extending in a gradually tapering tongue

of land, considerably and regularly curved to the eastward, and becoming very narrow towards the extremity. It presents the aspect of a low sandy beach; and yet, almost immediately from its western side, the water suddenly descends to a depth of sixty feet. A few miles north of the point, a rock appears, which I shall presently describe, and which I have no doubt forms the foundation of the peninsula, as it is manifest that the sand must have some solid basis to enable it to resist the storms of centuries. This rock has originally been a stratum of coarse sand, full of fragments of Balanus proteus, mixed with many whole specimens of the same, and of Pecten Madisonius, which abound on the upper surface. Much of the sand has been washed away, and the remainder of the stratum has become cemented by carbonate of lime, and oxide of iron. It is a very porous rock, with an exceedingly craggy or irregular surface, rising to a level of about six feet above the river. Over this rock is a stratum composed of mingled sand and clay, with the same fossils, in a friable state, four feet thick; then follows a bed of gravel, with an occasional pebble, one foot in thickness; and the highest stratum consists of clay without fossils, seven feet thick.

Near the mouth of St. Leonard's creek, resting on the fragmentary rock above described, is a stratum of fine siliceous sand, cemented by carbonate of lime, in which are imbedded innumerable casts of Perna maxillata. With these the Pholas ovalis occurs abundantly, a lithodomus bivalve, always accompanying the Perna in Maryland, the thick shell of which it perforated, and where it may often be obtained. This stratum is about twelve feet thick.

On the western shore of the Patuxent, in St. Mary's county, the fossilliferous strata are visible at the mouth of Cuckold creek, just above the level of the water, and continue in a range of cliffs, northward, to within about twelve miles of Benedict. These beds, dipping to the southeast, soon give place to the upper tertiary, below the creek, whilst up the river they gradually rise to an elevation of at least fifty feet, in places, above the tide. At the landing of Dr. Gilliams, a few miles north of the last named locality, a rock first makes its appearance, nearly on a level with the river, which is very similar in aspect to that on the opposite shore; but in place of Balani, the fragments of which it is chiefly composed, are those of a large Scutella, which I have named S. Aberti. Many perfect specimens have been originally imbedded among these small fragments; but owing to their perishable nature, and the incessant action of the waves of the Patuxent upon the loosely cemented, very porous rock, few can be obtained nearly entire. The fragments of Scutella are much in the same state, and appear to have been subjected to attrition in a manner precisely similar to those of the recent shells of Anastatia Island, on the coast of Florida, which constitute a mass sufficiently coherent to be used as a building material in St. Augustine. This Scutella rock is very clearly a member of the medial tertiary formation, being identified by casts of characteristic shells, and especially by the large Pecten Madisonius, which abounds in single valves. We traced this interesting stratum a distance of six miles north of Dr. Gilliams' landing. Here it rises to a much greater elevation, and beneath it another stratum of the same formation, full of casts of Perna maxillata, extends to the level of the river. This locality is near the landing of Chapman Billingsly, Esq., who received us with cordial hospitality, and politely assisted us in exploring the vicinity. Above the Scutella rock a thin bed of *Ostrea virginiana* occurs in sand. Two or three

miles north of Major B's landing, the cliffs are very high, and the arenaceous fossilliferous stratum becomes fifteen or twenty feet in thickness, and abounds in large bivalves. The sand is quartzose and incoherent, and has evidently been the undisturbed bed of the sea; for we find the bivalves, generally, not only entire, but imbedded just in the same position they had lived in when burrowing in their native beds. The large Panopea, so abundant here, is an excellent illustration of this, always having its valves in apposition, and placed vertically, like the recent *Myæ* of the sand beach beneath. The following list comprises most of the fossils of this locality. Those species which are yet in existence, are indicated by the names being printed in *italics:*

Bivalves.	*Bivalves.*
Artemis acetabulum, Conrad.	Isocardia rustica, Sow.
Arca idonea, Conrad.	*Lucina anodonta*, Say.
Anomia ephippium, Lin.	Mya prælonga, Conrad.
Astarte undulata, Conrad.	Orbicula lugubris, Conrad.
Cytherea Sayana, Conrad.	Perna maxillata, Lam.
Cytherea marylandica, Conrad.	Pholas ovalis, Say.
Crassatella marylandica, Conrad.	Pecten Madisonius, Say.
Cardium laqueatum, Conrad.	Tellina biplicata, Conrad.
Corbula idonea, Conrad.	Venus Mortoni? Conrad.
Diplodonta americana, De France.	
Univalves.	*Univalves.*
Buccinum trivittatum, Say.	Fusus quadricostatus, Say.
Dispotæa grandis, Say.	*Natica heros*, Say.
Fulgur tuberculatus, Conrad.	*Natica duplicata*, Say.
Fusus rusticus, Conrad.	Terebra simplex.
Fusus parilis, Conrad.	Serpula granifera, Say.

Coral—Madrepora palmata, Goldfuss.

The most interesting deposit of medial tertiary fossils, in St. Mary's county, is in the right bank of the river of that name, where the variety and perfection of the shells have long since attracted collectors and visiters to the spot. The precipitous shore extends at least two miles, interrupted by one small creek, south of which the following section is presented:

10 feet.	Mixed sand clay, without fossils.
2 feet.	Sand and clay, with the same shells as below.
5 feet.	Lead-colored clay, with— 3 group of shells, as given in the lists. 2 veins of Turritella plebeia. 1 Panopæa.

N.

St. Mary's river.

Many specimens of Arca idonea can be easily obtained here, with connected valves, in the stratum of clay; but excepting the Panopæa, the other large bivalves generally occur disunited. I have, however, occasionally found a whole Mactra ponderosa, Venus tetrica, V. alveata, Artemis acetabulum, and great abundance of the small Corbula cuneata. Fragments of shells, comminuted by attrition in the surf, occur plentifully in this deposit; which circumstance, in connection with the prevalence of single valves, shows that the deposition took place near enough to the ancient sea-beach to be influenced by the currents along the shore, or perhaps by the undercurrent of the surf, during the prevalence of violent tempests. In further confirmation of this, we observe, occasionally, a valve of an undetermined Ostrea, an estuary shell. One of the most abundant univalves is *Buccinum trivittatum*, a recent species of the eastern and middle Atlantic coast; and its usual associate in the present sea, *Buccinum lunatum*, is very common. *Natica heros*, and *N. duplicata*, (Say,) two recent univalves, with a similar geographical range, are of frequent occurrence in the clay. Some of the large univalves are most common in the arenaceous stratum, but none are limited to it. Occasionally, masses are found along the shore, which have been indurated by silex, originally in a gelatinous state, the surfaces studded by shells of various species. These siliceous beds, no doubt, are owing to the infusoria which existed in this tertiary period. North of Porto Bello, the residence of the Rev. Mr. Mitchell, the arenaceous stratum becomes of much greater thickness, and the shells are more friable; the cliff also rises to a greater elevation. Here the beautiful fossil *Artemis acetabulum*, is particularly abundant. To the south of this, near Windmill Point, Fusus quadricostatus, of Say, is more numerous and perfect than in any other known locality of the formation. The beach, for nearly a mile, is strewed with fine fossil shells of the large bivalves and univalves, in great perfection, among which the most conspicuous are, Mactra ponderosa, Venus tetrica, V. Mortoni, *Artemis acetabulum*, Fusus parilis, F. quadricostatus, and Voluta mutabilis. The east bank of the river presents a cliff of nearly the same elevation, fifteen or twenty feet. The clay rises about three feet above the level of the water, containing the same group of shells, largely mixed with fragments, which prevails on the opposite shore. The top of the arenaceous stratum is here become a hard ferruginous rock. Near the southern termination of the cliff, towards the mouth of St. Inigoe's creek, the fossils are no longer visible, except in indistinct impressions, the material of the shells having been converted, in nature's grand laboratory, into splendid masses of selenite, many of which are twelve inches in diameter, and profusely imbedded in clay near the level of the beach. Near this locality we remained several days, under the hospitable roof of our excellent friend Dr. James W. Roach.

Organic Remains found on St. Mary's River.

Univalves.	*Univalves.*
Actæon ovoides, Conrad.	*Natica heros*, Say.
Bulla acuminata, Sowerby.	*Natica duplicata*, Say.
Buccinum trivittatum, Say.	Pleurotoma bicatenaria, Conrad.
Buccinum lunatum, Say.	Pleurotoma limatula, Conrad.
Buccinum quadratum, Conrad.	Pleurotoma communis, Conrad.

Univalves.	*Univalves.*
Conus diluvianus, Green.	Pleurotoma parva, Conrad.
Cancellaria lunata, Conrad.	Pleurotoma rotifera, Conrad.
Cassis cœlata, Conrad.	Pleurotoma gracilis, Conrad.
Dentalium dentalis, Lam.	Pleurotoma dissimilis, Conrad.
Dispotæa costata, Say.	*Scalaria clathrus.*
Dispotæa grandis, Say.	Scalaria expansa, Conrad.
Fusus tetricus, Conrad.	Terebra simplex, Conrad.
Fusus sulcosus, Conrad.	Terebra loxonema, Conrad.
Fusus rusticus, Conrad.	Trochus humilis, Conrad.
Fusus cinereus, Say.	Trochus reclusus, Conrad.
Fusus quadricostatus, Say.	Turritella plebeia, Say.
Fusus parilis, Conrad.	Turritella variabilis, Conrad.
Fusus strumosus, Conrad.	Typhis acuticosta, Conrad.
Fulgur coronatus, Conrad.	Voluta solitaria, Conrad.
Fulgur fusiformis.	Voluta mutabilis, Conrad.
Fulgur canaliculatus.	Turritella laqueata, Conrad.
Bivalves.	*Bivalves.*
Artemis acetabulum, Conrad.	Mactra subcuneata, Conrad.
Astarte planutata, Conrad.	Ostrea ——————?
Amphidesma carinata, Conrad.	Pecten Madisonius, Say.
Arca idonea, Conrad.	Pholas arcuata, Conrad.
Cardium laqueatum, Conrad.	Pholadomya abrupta, Conrad.
Cardita granulata, Say.	*Saxicava rugosa?*
Corbula cuneata, Say.	*Solen ensis?*
Cytherea Sayana, Conrad.	Venus alveata, Conrad.
Isocardia rustica, Sow.	*Venus Mortoni*, Conrad.
Lucina cribraria, Say.	Venus tetrica, Conrad.
Mactra ponderosa, Conrad.	

Multivalves.

Balanus proteus, Conrad.
Balanus ovularis, Lam.

From all the various localities of this formation I have obtained about two hundred and thirty-nine species of shells and corals; among these I find thirty-six species which are now existing on the coast of the United States. The number of recent, compared with extinct forms, will therefore bring this formation within the limits of the miocene period. My only doubt, heretofore, has been that it could be referred to the era of the Bordeaux deposits; but since Mr. Lyell has suggested that the latter may be an older portion of the miocene than the crag of England, which I have always regarded as identical in age with our medial tertiary, I have no longer any objection to refer the formation in question to the miocene period. I claim to have made this discovery solely by my own investigations.

POST-PLIOCENE PERIOD.

Upper Tertiary Formation.—About one mile south of Hopewell's Landing, on the

Patuxent, or the mouth of Town creek, the bank of the river presents a stratum of *Ostrea virginiana*, the shells not differing much in size and appearance from the recent oyster of the vicinity, and which might by some observers be referred to Indian agency. But this is a bed of nearly uniform thickness, traceable several miles, and frequently five or six feet beneath the surface. Some miles south of Town creek, on the farm of Dr. Neale, this bed of oyster shells lies six feet below the summit of the bank; and I noticed many shells with connected valves, among those which are disunited, probably about the same proportion which obtains among the recent species of the more exposed estuaries and lagoons. The following section will convey some idea of the bank at this place:

Patuxent.	6 feet.	Sand without organic remains.	N.
	2 feet.	Mixed sand and clay with oyster shells.	
	1 foot.	Large gravel and sand without shells.	
	10 feet.	Dove-colored clay with ferruginous seams, and full of small crystals of selenite.	

About five miles south of the estate of Dr. Robert Neale, at whose mansion we were most kindly received, we visited a more interesting deposit of the same age, inasmuch as the oceanic shells make their appearance in the bank of the Chesapeake, as represented in the following section:

Chesapeake.	4 feet.	Whitish clay. No fossils.	N
	4 feet.	Gravel.	
	3 feet.	Clay, without shells.	
	4 feet.	Clay, with marine shells, very chalky, among which are *Mactra lateralis*, *Pholas costata*, *Arca transversa*. All the species here are yet in existence.	
	7 feet.	Clay, similar to that last described, with an occasional oyster shell, and a few small pebbles.	

From observations made on the shores of the Chesapeake and Potomac, it is clear that the upper tertiary borders the lower part of the peninsula, from near the mouth of Town creek on the Patuxent, to a point on the Potomac about half way between St. Mary's river and Brittain's bay. But I am disposed to extend the limits of this formation, in order to include most of those deposits of oyster shells, which are sup-

posed by many to have been distributed along shore by the Indians. These abound on the Patuxent, in St. Mary's county, as well as in many places throughout the tertiary region of Maryland and Virginia. Major Southron, who resides below Benedict, on the Patuxent, informs me that he has seen them in a bed ten feet thick; and on the Wicomico, it is said, they occur thirteen feet in thickness, covering many acres. The objections to these being deposits by Indians are at least worthy of notice, and may serve to stimulate inquiry. In the first place, the beds are of considerable extent, often at some distance from the water courses, and of no greater variation in thickness than the marine deposits of the more ancient tertiaries. Many entire shells are found among the unconnected valves. They are sometimes imbedded in sand, and others in a black mould, such as would be formed by the mud of estuaries mixed with lime, from the decomposing shells. These beds are always beneath the soil covered originally by the forest. At Easton, on the Eastern shore of Maryland, fragments of extinct species of Pecten are found among them. On the south shore of Raritan bay, the shells occur in a regular stratum, generally in single valves, mixed with an occasional specimen of *Fulgur canaliculatus*, just in proportion to the living individuals of both species in Raritan bay. On the Chesapeake, below the Patuxent, they occur at least eight feet below the surface of the country around, and were traced in a continuous deposit of nearly uniform thickness, about four miles in extent. The position and character of these deposits correspond with those of the Gnathodon on the Potomac, which might with just as much reason be referred to Indian agency, as well as the immense accumulation of the same shells for hundreds of miles along the northern shore of the Gulf of Mexico, in which it is said that Indian idols or small images have been found. Mr. Abel, who resides above Town creek, on the Patuxent river, informs me, that oyster shells, many of them with the valves in apposition, are found in his vicinity, in a bed two feet thick, ten feet beneath the surface. I shall not at present pursue this subject, intending to investigate it more leisurely at a future period, when I design to publish a more detailed history of these interesting beds. In conclusion, two important deposits of the upper tertiary will be noticed. One on the Potomac, near its junction with the Chesapeake bay, and the other on Neuse river, North-Carolina. The first of these was described by me in 1830, in the journal of the Academy of Natural Sciences, of Philadelphia, in which paper appeared the first attempt to classify and describe any of the tertiary formations of North-America.

Section near the mouth of Potomac.

Elevation fifteen feet.

		Sand and gravel.
	1 foot thick.	*Ostrea virginiana, Mytilus hamatus,* (estuary deposit,) sand.
Chesapeake.	8 feet above tide.	Clay with { *Pholas costata, Mactra lateralis, Arca transversa, Solecurtus caribæus, &c.,* (marine deposit.)

About three miles above the low sandy point which forms the southern extremity of the Western peninsula of Maryland, the bank of the Potomac rises to an elevation of about fifteen feet at its highest point. The fossils are visible in this bank a quarter of a mile in uninterrupted extent. The inferior stratum is a lead-colored clay, containing great numbers of *Mactra lateralis*, (Say,) a common recent bivalve of the coast, which in many instances appear in nearly vertical veins, having evidently fallen into fissures in the clay. *Pholas costata* is also abundant, and each individual remains in the position in which the living shell is usually buried in the mud, that is, vertical, with the anterior or short side pointing downward. They are very fragile and can rarely be procured entire. Over the clay reposes a bed of *Ostrea virginiana* in sand, in places a foot in thickness. It is nearly horizontal, varying from a height of four, to eight or ten feet above high water mark. The fossils of this locality, with two exceptions, are common recent species of the Atlantic coast, and in some instances the original colored markings remain upon the shells. Were it not for the occurrence of *Gnathodon cuneatus*, *Mytilus hamatus*, and *Arca ponderosa*, the group would not vary from that now inhabiting the coast as far north as Massachusetts; but the presence of these three bivalves indicate that a climate equivalent to that of Florida prevailed when the shells of this locality were living in the sea. I have before alluded to the peculiar and highly important distribution of the existing *Gnathodon*, burrowing in myriads in the mud flats near Mobile, and confined to the estuaries of the Gulf of Mexico. An occasional water worn valve in the deposit on the Potomac, above described, seemed to indicate that the species lived in that river in the upper tertiary period. This conjecture was converted into certainty by an exploration of the shore farther north, which resulted in discovering a bed composed exclusively of the *Gnathodon*, on the land of Mr. Ebb, above the mouth of St. Mary's river. This bed, except that the shells are smaller, is precisely similar to those which line the bay shore near Mobile. The valves of the shells are frequently connected, and there can be no doubt that here was the spot where they lived, and were imbedded; that this was a region of sand flats bared at low tide, the water brackish, as it is now, and that the deposit near the mouth of the Potomac was of the same period, but more directly communicating with the ocean. The species found here are as follow:

Univalves.	*Univalves.*
Aetæon melanoides, Conrad.	*Buccinum obsoletum*, Say.
Crepidula convexa, Say.	*Buccinum trivittatum*, Say.
Crepidula glauca, Say,	*Natica duplicata*, Say.
Fusus cinereus, Say.	*Ranella caudata*, Say.
Bivalves.	*Bivalves.*
Arca transversa, Say.	*Pandora trilineata*, Say.
Arca ponderosa, Say.	*Petricola pholadiformis*, Lam.
Corbula contracta, Say.	*Pholas castata*, Lam.
Gnathodon cuneatus, Gray.	*Sanguinolaria fusca*, Say.
Cytherea Sayana, Conrad.	*Tellina lusoria*,
Mactra lateralis, Say.	(Psammobia lusoria, Say.)
Mya arenaria.	*Solecurtus caribæus*, Lam.

Bivalves.	*Bivalves.*
Mytilus hamatus, Say.	*Solen ensis*, Lam.
Nucula limatula, Say.	*Venus mercenaria*, Lam.
Nucula acuta, Conrad.	

The entire thickness of the tertiary clays has not been determined, but it has been ascertained that they sink to a very considerable depth, enough to convey the idea of a vast period of time elapsing between their origin and final deposition. Deep harbors and bays seem to have been filled up by the very gradual accumulation of fine silt or mud; generations of shells were entombed in frequent succession, until the harbors, bays, or part of the ocean itself shrinking into shallow lagoons, no longer furnished the conditions necessary to their increase, and myriads of oysters took possession of their deserted beds. There is no pause, no interruption to this ceaseless mutability. Our harbors and our bays must, in the lapse of ages, be filled up by the unfailing influx of silt; our present beds of oysters be converted into dry banks of shells. New bays will succeed to those which we now behold; and other lagoons will encroach upon the sea. Whoever attentively examines the locality last described, on the Potomac river, will be forcibly reminded of the mutability of the present features of our earth; he can read distinctly the history of the past, and anticipate, in a measure, the annals of futurity, the new order of things, the relative condition of sea and land yet to be, long after he has passed away, and his name, his influence, his labors having left no more trace of his existence than the "baseless fabric of a vision."

In Silliman's Journal of Science and Arts, I have noticed a spot on the Neuse river, in North-Carolina, of more than ordinary interest, in consequence of the quantity of bones of land animals which are mingled with the upper tertiary shells. This place is about fifteen miles below Newbern, on the left bank of the river, and the two formations of medial and upper tertiary are in juxtaposition. The former, when I visited the spot, was concealed from observation, the excavations having been filled up, and the beds being nine feet beneath the level of the Neuse. Mr. Benners, who owned the land, informed me that all the bones were above this formation, mixed with the upper tertiary shells. These remains are nearly all water worn, black and silicified, and have evidently been transported from a distance, probably carried by ice down the ancient Neuse, and dropped among the shells of the upper tertiary period. The bank of the river is here not in any part more than twenty feet high. The surface of the fossilliferous portion is very irregular, rising in a few places to the height of ten feet above the river. Its visible part consists of a mixture of sand and clay, in which are imbedded immense numbers of *Mactra lateralis*, and abundance of *Solen ensis*, towards the top of the stratum. The shells with two exceptions, are such as now exist on the southern coast of the Atlantic, and in the Gulf of Mexico, and the evidence of a climate very similar to that of the locality last described on the Potomac, is perfectly satisfactory. The *Gnathodon* occurs here, and the whole group is very well represented in the Gulf of Mexico at the present day.

List of Fossil Shells at Benners's.

Univalves.	*Univalves.*
Buccinum trivittatum, Say.	*Fulgur canaliculatus.*

Univalves.	*Univalves.*
Crepidula fornicata, Say.	*Oliva litterata*, Lam.
Crepidula unguiformis, Lam.	*Terebra dislocata.*
Cryptostoma perspectiva, Say.	*Vermetus lumbricalis.*
Fulgur carica.	
Bivalves.	*Bivalves.*
Anomia ephippium, Lam.	*Nucula limatula*, Say.
Arca ponderosa, Say.	*Nucula proxima*, Say.
Arca transversa, Say.	Nucula acuta, Conrad.
Amphidesma æquale, Say.	*Pholas costata*, Lam.
Amphidesma bellastriata, Conrad.	*Pecten dislocatus*, Say.
Artemis concentrica.	*Solecurtus caribæus*, Lam.
Cumingia tellinoides, Conrad.	*Solen ensis*, Lam.
Cytherea Sayana, Conrad.	*Tellina alternata*, Say.
Cardium magnum, Born.	*Tellina lintea*, Conrad.
Cardium isocardia, Lam.	*Tellina lusoria*, Say.
Gnathodon cuneatus, Gray.	*Venus permagna*, Conrad.
Lutraria canaliculata, Say.	*Venus cancellata.*
Mactra lateralis, Say.	

I have alluded in this essay to the fact that the eocene and miocene are not connected by a single species common to both. It is equally remarkable that very few are common to the miocene and the newer deposits, and they, with one exception, are recent species. The conclusions derived from my investigations are, that the American tertiaries are of the eras of the eocene, miocene, and post-pliocene, and that the newer pliocene is either wanting, or has not yet been observed.

In concluding this brief sketch of a portion of the tertiary region, I will take occasion to remark, that it is my intention when I have fulfilled my obligations to the State of New-York, in publishing the organic remains in connection with its geological survey, to investigate the Atlantic tertiaries more thoroughly, and to submit the results of my labors to the National Institution. In the mean time, gentlemen who reside within the limits of that extensive district would contribute greatly to the advance of American geology, if they would send to the National Institution specimens, in good condition, of all the various organic remains on their plantations.

DESCRIPTIONS OF NEW TERTIARY FOSSILS.

LOWER TERTIARY OR EOCENE FOSSILS.

OSTREA.—(*Lin.*)

Ostrea sellæformis, pl. 1, fig. 1.—This singular oyster, the history of which I have briefly given, appeared so important, in a geological point of view, that I have here introduced a figure of the species, although it had been published, in 1832, in my "Fossil Shells of the Tertiary Formations," page 27, pl. 13, fig. 1, 2. The

figure now given is from a much more perfect specimen, which I found on James river, Virginia, a few miles below City Point.

SYNONYMES.

Ostrea radians, (nob.)—Fossil Shells of Tertiary Formation, pl. 13, fig. 1, (upper valve.)

Ostrea semilunata, (Lea.)—Contributions to Geology, pl. 3, fig. 69, (young.)

Ostrea divaricata, (Lea.) Do. do. fig. 70, (young lower valve.)

Having carefully studied this species in all stages of growth, in several localities, the above synonymes are undoubtedly correct.

PHOLADOMYA.

Pholadomya marylandica, pl. 1, fig. 3.—Ovate, profoundly ventricose, with coarse, irregular, concentric lines and furrows, and obsolete, rather distant, radii; summit of umbo prominent.

Locality: Piscataway, Prince George's county, Maryland.

PHOLAS.

Pholas petrosa, pl. 2, fig. 4.—Ovate-acute; anteriorly profoundly ventricose; radii sharp and numerous; dorsal margin obliquely rectilinear from the summit of the umbo; base obliquely subrectilinear; posterior side produced, cuneiform.

Locality: Occurs with the preceding species.

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MEDIAL TERTIARY SPECIES.

ISOCARDIA.—(*Lam.*)

Isocardia Markoëi, pl. 2, fig. 1.—Suborbicular; length and height nearly equal; inflated; umbo very prominent, and the beaks profoundly incurved; posterior margin direct, arched above, nearly straight below, and obtusely angulated at its junction with the base; base regularly, not profoundly arched; posterior slope slightly sinuous.

Locality: Captain Hance's farm, Calvert Cliffs, Maryland.

This beautiful species is easily distinguished from I. rustica, (*I. fraterna*, Say,) by the much more prominent umbo, and greater curvature of the beak, and in being proportionally much shorter. The young shells of the two species are widely unlike each other in outline, this species being round, and the *rustica* of a long, ovate figure.

Deshayes considers the *I. fraterna*, (Say,) to be identical with *I. cor*. Upon comparison, the latter was found to have a far more profound arch or rotundity to its base, as well as much greater curvature of beak; but the difference in the young shells, of either species, is so profound, that any idea of their identity would be instantly abandoned by comparison.

Mr. Markoe obtained three or four valves of this shell, and one specimen with connected valves, and I have much pleasure in dedicating the species to him, as a slight tribute of respect for his talents, zeal, and most generous devotion to science.

PECTEN.—(*Lam.*)

Pecten Humphreysii, pl. 2, fig. 2. Suborbicular, inferior valve convex; superior flat, and with about seven remote, narrow, convex ribs, and concentrically wrinkled; towards the apex is a concave depression; ears equal, sides direct and straight; inferior valve with the ribs wide, approximate, plano-convex and longitudinally striated; one of the ears emarginate at base.

Localities: Near Fairhaven, Anne Arundel county, Md. Mr. Wilkinson's farm, in Calvert county. I am indebted to Dr. Humphreys, of Annapolis, for the loan of the specimen figured, that which I found at Fairhaven being too imperfect for the purpose. I gladly attach the name of this gentleman to the species, in consideration of his love of and proficiency in scientific pursuits.

Of two specimens in the collection of the college at Annapolis, the largest measures three inches from beak to base.

DISPOTÆA.—(*Say.*)

Dispotæa constricta, pl. 1, fig. 2.—Shell irregular, elevated; laterally compressed, marked with simple lines of growth; apex prominent, with one or two minute volutions; diaphragm very profound.

Locality: Captain Hance's Landing, Calvert Cliffs, Maryland.

SCALARIA.—(*Lam.*)

Scalaria expansa, pl. 2, fig. 3.—Shell acutely ovate, moderately thick, with numerous robust recurved ribs, twelve in number, counting from the summit of the aperture to the reflected lip, inclusive; whirls profoundly ventricose at the sides, somewhat flattened above; four or five in number.

Locality: St. Mary's river, Maryland.

Two specimens of this fine Scalaria were obtained by Mr. Markoe, and none other is known to have been discovered.

BUCCINUM.—(*Lam.*)

Buccinum integrum, pl. 2, fig. 5.—Shell short, subfusiform or elliptical; smooth; destitute of ribs or striæ; spire conical, the volutions convex; aperture elliptical, about half the length of the shell; columella thick; labium reflected.

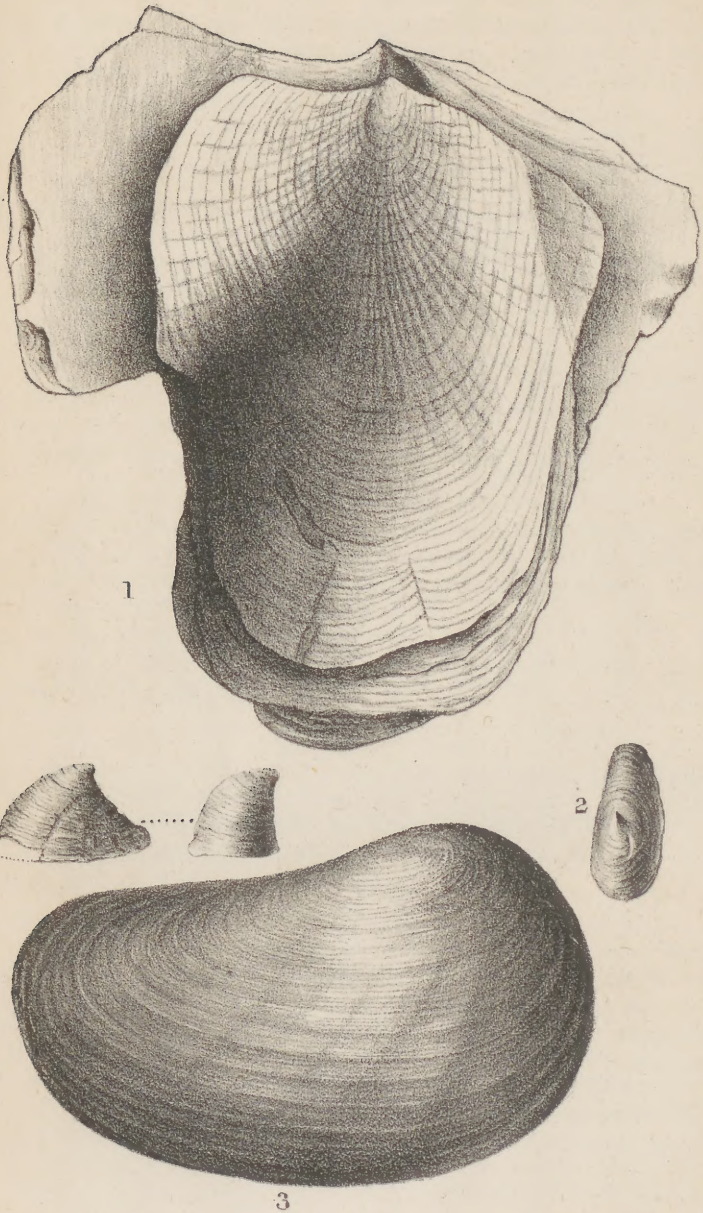
Localities: St. Mary's river and Calvert Cliffs, near the mouth of Patuxent river.

SCUTELLA.—(*Lam.*)

Scutella Aberti.—Discoidal, orbicular, very much depressed, but swelling towards the middle, and depressed at the apex; diameter five and a half inches.

Locality: Patuxent river, St. Mary's county, Maryland.

This large Scutella is very abundant; but those I have, at present, are too imperfect for minute description. A figure of it will be published when specimens in better condition shall be obtained. It is dedicated to my scientific friend Colonel J. J. Abert, of Washington, whose name it gives me great pleasure thus to connect with the tertiary rocks of Maryland.



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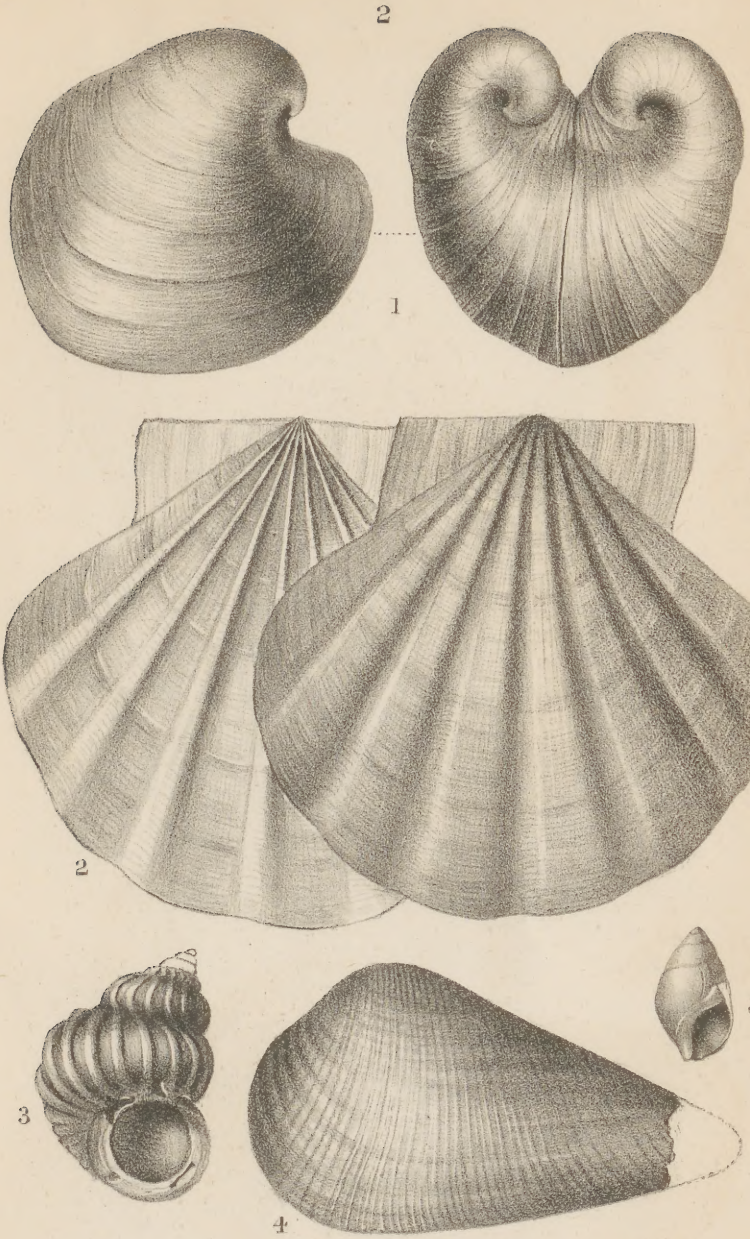

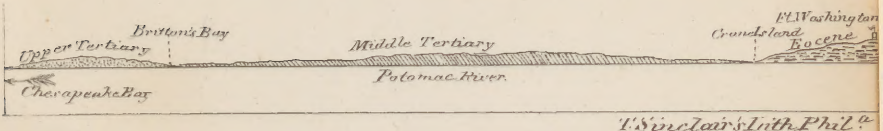

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